

REMARKS

Claim 21, 22, 27-31, 55-59, 64-68, 71, 73-76, 78-81 and 83-87 are rejected under 35 U.S.C. 102b as being anticipated by U.S. Patent 6,023,338 to Bareket. The rejection is respectfully traversed.

It is believed to be well settled that in order for a reference to anticipate a claim, there must be identity of elements between those of the reference and those of the rejected claim. Bareket clearly fails this test. For example, Claim 21 requires that the periodic structures that are illuminated with incident radiation be overlying or interlaced and further that diffracted radiation from the illuminated portions of the overlying or interlaced periodic structures be detected to provide an output signal. This is not the case at all in Bareket. Since the periodic structures in Claim 21 are either overlying or interlaced, they need not be illuminated by more than one illumination beam. Furthermore, the diffracted radiation that is detected is diffracted from all of the overlying or interlaced periodic structures. It is not possible to differentiate radiation diffracted by a first periodic structure as opposed to radiation diffracted by a second periodic structure overlying or interlaced with the first structure. The overlying or interlaced periodic structures of claim 21 are illustrated in the embodiments in Figs. 2a, 2b, 4a, 4b, 5a and 5b of the present application. This is not the case at all in Bareket.

In Bareket, in contrast, the two periodic structures that are measured are not overlying or interlaced. Instead, they are placed side by side even though they may be from different layers. Therefore Bareket requires two separate beams: one for illuminating each of the two periodic structures. Each of the two periodic structures then reflects its corresponding illumination beam and the reflected light from each of the two

structures is detected by a separate detector. Thus as opposed to the method of Claim 21 where it is not possible to differentiate between radiation diffracted by the different periodic structures that are overlying or interlaced, in Bareket, the light reflected by one structure is entirely separate from the light reflected by the other structure and the reflected light from the two structures are detected by two separate detectors. The fact that the two periodic structures of Bareket do not overlies but are instead placed side by side is clearly described in Bareket, for example, in column 3, lines 36-43.

In view of the above, there is a fundamental difference between the measurement scheme of Bareket and the detection scheme of the method of Claim 21. There is therefore no identity of elements between Bareket and Claim 21. Furthermore, in view of the fundamental differences described above it is further believed that there is no reason or motivation to modify Bareket in order to arrive at the method of Claim 21. The method of Claim 21 is therefore believed to be allowable.

Claim 22 is believed to be allowable since it depends from allowable Claim 21.

Claims 27-31 are believed to be allowable since they depend from allowable claims; they are further believed to be allowable on account of limitations in these claims.

As for Claim 27, the Examiner is of the opinion that Bareket discloses that "the diffracted radiation includes positive and negative first-order diffraction." While Bareket does disclose positive and negative first-order diffraction in reference to Fig. 6b and column 9, lines 66 through column 10, line 20, the two first diffraction orders are merely used to provide the two illumination beams 210a and 210b and not the first diffraction orders from the periodic structures on the sample that is being measured. Thus as clearly described in the section of Bareket referenced above in columns 9 and 10, a diffraction grating 135 is used to split an illumination beam from source 140 into two separate illumination beams 210a and 210b, each for illuminating one of the two separate spots (250a, 250b) as shown in Fig. 6b. Then, as described in reference to Fig. 2 of Bareket,

the reflected light beams from the two illuminated spots 250a and 250b are each detected separately by a different detector. In other words, only reflected light from the sample 100 is detected, and neither a positive nor negative first order diffraction is detected, contrary to the opinion of the examiner.

Claim 30 also adds limitations which are not taught or suggested by Bareket. Thus Claim 30 adds the limitation that the derived signal contains information related to differential intensity, differential phase, or differential polarization angle. The differential intensity, differential phase and differential polarization angle referred to the enumerated differential quantities between the positive and negative first-order diffracted radiation. Since Bareket detects only reflected light and not first-order diffracted radiation, Bareket likewise fails to teach or suggest the limitation of Claim 30.

The neutral polarization angle, according to one definition, is an incident polarization angle where the differential intensity is equal to zero for all overlay mis-registrations. See page 3, lines 15-17 of the present application. Differential intensity refers to the difference in intensity between the positive and negative first-order diffracted radiation. Thus the neutral polarization angle or quasi-neutral polarization angle of Claim 31 has nothing to do with the phase difference between waveforms 310a and 310b in Fig. 4 of Bareket. We therefore disagree with the Examiner's reasoning for rejecting Claim 31 referring to column 6, lines 48-55 and column 6, lines 65 to column 7, line 12 of Bareket. Such section of Bareket, or any other section thereof, simply fails to disclose any feature even remotely resembling the feature of claim 31.

In Claim 55, the patterned structures are in two regions located one above the other in two different layers. In other words, one of the patterned structures is on top of or over the other patterned structure as illustrated in the embodiments in Figs. 2a, 2b, 4a,

and 4b of the present application, so that all of the above-described differences between Claim 21 and Bareket applies in a similar manner to Claim 55. Therefore for the same reasons as those discussed above for Claim 21, Claim 55 is likewise believed to be allowable. The same can be said for Claims 74 and 84-87.

As for Claims 56 and 75, the Examiner is of the opinion that the feature in these claims are disclosed by Bareket in column 3, lines 56-57. We respectfully disagree. The two identical grating patterns 20 and 30 referred to in column 3, lines 55-56 of Bareket are not the patterned structures that are measured and compared for lateral shift measurement and are therefore different from the patterned structures referred to in Claims 56 and 75. As noted by Bareket in column 3, lines 59 and 60, the left grating 20 is for x-axis registration measurements and the right grating 30 is for y-axis registration measurements. In other words, the two grating patterns 20 and 30 are used independently of each other, one for measuring mis-alignment along the x-axis and the other one used for measuring mis-alignment along the y-axis. Therefore the fact that patterns 20 and 30 have the same periodicity is irrelevant in regard to claims 56 and 75. Claims 56 and 75 are also believed to be allowable since they depend from allowable claims.

Similar to Claims 21 and 55 discussed above, the two regions in the additional sites in Claims 57, 69 and 76 are located one above the other and are therefore fundamentally different from detection scheme of Bareket; therefore they are believed to be allowable on account of the features in these claims for the same reasons as those described above for claim 21. Claims 57-59, 69, 76 and 79 are also believed to be allowable since they depend from allowable claims.

The parameter detected in Claim 64 is indicative of a lateral shift between the patterned structures that are one above the other. This is radically different from the differential phase information of column 7, lines 53-68 and column 8, lines 4-15 of Bareket since the periodic structures giving rise to phase differences between reflected light measured by Bareket are placed side by side and not one over the other. The parameter measured in Claim 78 is a function of a variable related to information of the diffracted light from the two patterned structures that are placed one above the other so that it is not possible to separate light diffracted by one structure from that diffracted by the other structure. This is again different from the phase or differential phase of Bareket in column 7, lines 53-68 and column 8, lines 4-15 since the periodic structures giving rise to phase differences between reflected light measured by Bareket are placed side by side and not one over the other.

Claims 64-68, 71, 73, 78, 80, 81 and 83 are also believed to be allowable since they depend from allowable claims. They are further believed to be allowable on account of the features in these claims. Thus, Claim 71 adds the feature that the analyzer analyzes the parameter obtained in association with a database to determine an existing lateral shift between the layers of a sample. Bareket clearly fails to teach or suggest such a feature. We disagree with the Examiner that column 7, lines 8-40 of Bareket discloses such feature. If the Examiner disagrees, it is respectfully requested that the Examiner point out exactly the disclosure in such section of Bareket that discloses the feature. Instead, we believe that Bareket calculates the registration error using the formula $D=P*\phi$, where P is the grating period, and ϕ is the calibrated phase difference between the two signals. See column 8, lines 20-23 of Bareket. As can be seen from such section of Bareket, Bareket

calculates the registration error without using any database. In view of Bareket's method of calculating the registration error, a database is simply not necessary or desirable. This is further explained below in relation to the rejection of claim 23.

As for Claim 33, the Examiner is of the opinion that it is anticipated by U.S. Patent 6,710,876 to Nikoonahad et al. The rejection is respectfully traversed.

The Examiner is of the opinion that Nikoonahad discloses a source providing polarized light to illuminate interlaced periodic structures referring to column 7, lines 5-10. We respectfully disagree. Column 7, lines 5-10 of Nikoonahad discloses nothing more than diffracting a coherent beam of radiation 102 in order to split it into two beams 102a and 102b using polarizing beamsplitter 104. Such section of Nikoonahad simply fails to disclose any "interlaced periodic structures."

The Examiner is also of the opinion that Claim 36 is disclosed by Nikoonahad in column 7, lines 13-15. We respectfully disagree. Claim 36 requires a device causing relative rotational motion between the polarizer and the analyzer. There is simply no such element in Nikoonahad, either in the section referred to by the Examiner, or in the rest of Nikoonahad. The modulator 106 described in column 7, lines 13-15 of Nikoonahad merely shifts frequencies and does not cause any relative rotational motion between the polarizer and analyzer.

Claim 23 is rejected under 35 U.S.C. 103a as being unpatentable over Bareket. The rejection is respectfully traversed. The Examiner admits that Bareket fails to disclose that the reference signal comprises a database. She is nevertheless of the opinion that "since the computer performs and controls measurement and calculations, it would have been obvious to one having ordinary skill in the art at the time of invention to

include the reference signal in a database as a means to provide an updated and accurate signal for comparison.” We respectfully disagree.

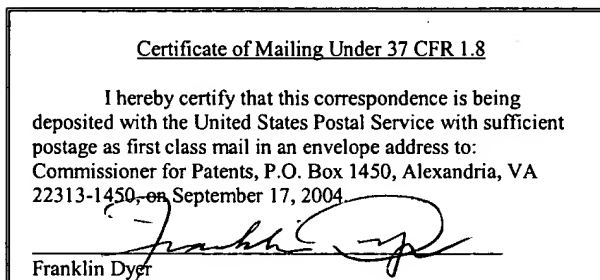
As noted above, the registration error is calculated by the formula $D=P*\phi$. Given the nature of the calculation, it appears that there is no need for any updating of any reference signal. The examiner has not explained what in her view is the reference signal in Bareket or why any updating of any signal (reference signal?) is necessary or desirable. Bareket’s measurement scheme is based on a design where measurement errors caused by mis-position of the two illumination beams relative to the patterned structures, as well as any other errors introduced by the measurement system itself, are cancelled by simultaneously measuring the reflected light from the two illuminated spots. If any updating of any signal in a database results in calculating the misalignment from light reflected from the illuminated spots at different times, the errors introduced by the measurement system itself will not cancel, and it may not be possible to correct for mis-position of the beams. To the extent that the reason given by the examiner in rejection of Claim 23 is understood correctly to cause such results, we believe that such reason is not applicable and does not support the rejection. If the rejection is maintained, it is respectfully requested that the examiner explain in detail what signal is being updated, why one skilled in the art would be motivated to update any signal at all in Bareket’s scheme, and how such updating results in a more accurate result. Since the rejection appears to be unclear to the extent one would have to guess the meaning and basis for the rejection, if this rejection is maintained, it is believed that the next action should not be a final action.

Claims 44 and 47 are rejected under 35 U.S.C. 103a as being unpatentable over Nikoonahad. The rejection is respectfully traversed. The Examiner is of the opinion that Nikoonahad discloses the measurement of interlaced periodic structures referring to column 7, lines 5-10. As noted above, such section of Nikoonahad fails to disclose any interlaced periodic structures.

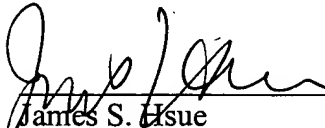
The Examiner is of the opinion that Nikoonahad discloses modulators providing relative motion in Nikoonahad in column 7, lines 13-15. As noted above, such section of Nikoonahad fails to disclose such feature.

We appreciate the indication from the Examiner that Claims 24-26, 32, 34, 35, 37-41, 45, 46, 48-52, 60-63, 70, 72, 77 and 82 would be allowable if re-written in independent form. This has not been done since the claims upon which they depend are also believed to be allowable.

Claims 21-41, 44-52 and 55-87 are presently pending in the application. Reconsideration of the rejections is respectfully requested and an early indication of the allowability is earnestly solicited.



Respectfully submitted,


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9/17/04
Date